LONG-TERM STEWARDSHIP STUDY

DRAFT

Prepared to comply with the terms of a settlement agreement:
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Office of Long-Term Stewardship

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Letter from Dr. Carolyn Huntoon
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The Department of Energy (DOE), including the National Nuclear Security Administration (NNSA), has prepared this *Draft Long-Term Stewardship Study* to comply with the terms of a settlement agreement between DOE, the Natural Resources Defense Council, and 38 other plaintiffs. The *Draft Study* describes and analyzes several significant national or cross-cutting issues associated with long-term stewardship. The Department identified these issues by conducting a public scoping process and considering information from a variety of other organizations that have considered long-term stewardship. Because the *Draft Study* is not a decision document, it does not attempt to describe how DOE intends to address these issues except where decisions already have been made. Where possible, the *Draft Study* identifies options for addressing these issues to promote information exchange and to inform the decision-making processes at the national level and at individual sites.

Many of the decisions framing DOE's long-term stewardship activities will be site-specific and depend on a variety of factors such as potential or future site missions, unique state, local, and Tribal requirements, and the ability of local communities and Tribal nations to maintain future land use controls. Many local issues can be discussed collectively on a programmatic basis. A better understanding of the challenges faced by DOE will allow individuals and organizations within and outside of the Department to make more informed decisions that shape future long-term stewardship activities, both nationally and at individual sites. The key challenges discussed in the *Draft Study* include:

- **Incorporating long-term stewardship considerations into cleanup decisions.** The term "cleanup" refers to the process of addressing contaminated land, facilities, and materials in accordance with applicable requirements. Cleanup does not imply that all hazards will be removed from the site. This function encompasses a wide range of activities, such as stabilizing contaminated soil; treating groundwater; decommissioning process buildings, nuclear reactors, chemical separations plants, and many other facilities; and exhuming sludge and buried drums of waste. The term "remediation" is often used synonymously with cleanup. Cleanup decisions have a significant influence on the "end state" (i.e., the physical condition reached when cleanup actions are complete) and on the resulting long-term stewardship requirements. Where a number of options are available to meet cleanup goals, more complete consideration of the long-term stewardship implications of each option would improve the Department's ability to plan for and implement long-term stewardship.

- **Ensuring the continued effectiveness of long-term stewardship if property ownership changes.** At some sites, DOE may transfer DOE owned or controlled property that requires long-term stewardship to other federal or non-federal entities. Under these circumstances, the Department will need to determine whether responsibility for long-term stewardship

should be transferred to the other entity in whole or in part; whether and how to impose management or use restrictions on the property; and how to oversee any restrictions or limits that are imposed. It may be difficult for DOE to enforce land use restrictions on land owned by someone else, particularly if ownership of the property continues to change hands.

- **Ensuring public access to information about residual hazards**. Successful implementation of long-term stewardship will depend on open public access to the appropriate information about the residual hazards at DOE sites; how they were generated; what the Department has done to reduce or mitigate the risks they pose; what ongoing long-term stewardship measures are required; and how long such measures are required. Continued protection of human health and the environment during long-term stewardship will depend upon public awareness and institutional openness. It will be difficult for the public to maintain land use restrictions without access to and understanding of information about residual hazards. However, public access to information needs to be balanced with legitimate security concerns.

- **Ensuring reliable and sufficient funding**. In the short term, annual Congressional appropriations provide an adequate mechanism for funding DOE's long-term stewardship activities. In the future, alternatives such as investment funds, mitigation funds, trust funds, commercial fees, or public-private partnerships may provide more stable sources of funding, although a variety of issues are associated with each funding alternative, including, in some cases, a lack of legislative authority to implement these options. Funding will be an important component of the overall long-term stewardship strategy at each site.

- **Maintaining continued partnerships with state, local, and Tribal governments**. States, local governments, and Tribal nations are likely to have some responsibility for certain long-term stewardship activities, including land use planning; developing and enforcing land use restrictions (e.g., zoning); and record-keeping (e.g., deed registration). Tribal nations also retain a unique political and legal status that requires federal trustee responsibility to protect the interests of Tribes. The affected communities surrounding DOE sites will need to be active participants in creating and maintaining institutions to transfer long-term stewardship information and responsibility over time.

- **Developing mechanisms to promote the sustainability of long-term stewardship**. Some of the residual hazards at DOE sites will almost certainly outlive any cleanup strategies that can be implemented using today's technologies. Unless advances in science and technology allow us to eliminate or otherwise reduce the hazards associated with long-lived substances, long-term stewardship responsibilities at most DOE sites will continue for many generations. Many aspects of human society, including cultural values, economic conditions, knowledge, science, and technology, will change over time. Therefore, mechanisms need to be developed to ensure that long-term stewardship survives, maintains focus, incorporates new science and technology, and re-evaluates requirements and strategies in light of these changes.

- **Building the concept of "pollution prevention" into the planning processes for new missions and facilities**. New missions at existing DOE facilities may generate long-lived wastes, wastes that have no clear path to disposal, surplus materials, or surplus facilities that

require long-term stewardship. The life-cycle environmental and cost impacts of mission operations, including those that occur during long-term stewardship, may be more easily mitigated if they are taken into account early in the planning process.

DOE has identified and discussed many of the issues associated with cleanup and the subsequent long-term stewardship requirements in two reports, and the Department has established an internet web site to better inform the public about cleanup and long-term stewardship issues.

- **The Accelerating Cleanup/Paths to Closure Reports**. Both the original report, published in June 1998, and the recent Status Report, published in March 2000, note that DOE cleanup efforts will not result in conditions that support unrestricted use at many sites.

- **The Background Document for this *Draft Study***. *From Cleanup to Stewardship, a Companion Report to* Accelerating Cleanup: Paths to Closure *and Background Information to Support the Scoping Process Required for the 1998 PEIS Settlement Study*, U.S. Department of Energy, Office of Environmental Management. DOE/EM-0466, October 1999.

- **The Long-Term Stewardship Web Site**. The site is available at ***http://lts.apps.em.doe.gov***.

Furthermore, the Department has taken steps to improve planning for long-term stewardship.

- **DOE established the Office of Long Term Stewardship**. The Office provides support and coordination among EM and other DOE offices. The Office has a major role in identifying policy and guidance needs; working with other DOE offices to develop and implement policies and communicate with national stakeholder groups; and coordinating with research and development organizations internal and external to DOE.

- **DOE formed the Long-term Stewardship Working Group**. The working group was established in 1998 to improve communication and coordination among DOE sites and organizations. The working group has provided guidance in preparing this *Draft Study* and is the focal point for DOE review of materials related to long-term stewardship (for example, draft Environmental Protection Agency guidance on CERCLA 5-year reviews).

- **Each DOE site is preparing a Project Baseline Summary (PBS) for long-term stewardship**. Guidance for preparing the EM annual budget directs each DOE site to prepare an independent PBS for long-term stewardship activities. At sites where this PBS is implemented, as cleanup projects are completed, budget requests, cost estimates, and performance metrics for the follow-on long-term stewardship activities will be shifted into this PBS.

- **DOE sites are preparing site-specific long-term stewardship plans**. The Grand Junction Office (GJO) in Colorado is responsible for long-term stewardship at more than 25 sites where cleanup is complete. The Office currently requires development of a site-specific long-term stewardship plan before accepting long-term stewardship responsibilities for any site. Other DOE sites have prepared comparable plans such as Resource Management Plans.

- **DOE is preparing a Report to Congress on long-term stewardship**. The Report to Congress requested in the FY 2000 National Defense Authorization Act will identify sites or portions of sites where environmental restoration, waste disposal, and facility stabilization will be completed by 2006 without unrestricted land use and will describe the necessary management and long-term stewardship responsibilities for these areas, including cost, scope and schedule. The Report to Congress will include the Department's most comprehensive estimate of long-term stewardship costs to date.

The Department of Energy recognizes that long-term stewardship is critical for ensuring continued protection of human health and the environment and is taking steps to develop policies, guidance, and procedures for planning and implementing long-term stewardship. This report, however, identifies a number of important issues and challenges that will need to be addressed. The success of long-term stewardship will depend upon a strong, open partnership between the Department, affected parties, and the general public. We welcome your comments; all comments should be submitted within 45 days of publication of the Notice of Availability in the *Federal Register*, as described in Section 1.2 of the *Draft Study*. With your help, we will continue to build a strong and sustainable long-term stewardship program.

Thank you again for your continued work on issues related to this *Draft Long-Term Stewardship Study*.

Sincerely,

Carolyn L. Huntoon

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Assistant Secretary
for Environmental Management

Chapter 7: Information Management

As DOE sites make the transition from cleanup to long-term stewardship, site stewards will need detailed, accurate information about the location and nature of residual hazards and the processes and cleanup strategies that generated these hazards. Other people will need to have access to this information, including health professionals, neighbors who live and work in the surrounding communities, and off-site entities who are responsible for some institutional controls, emergency response, and community planning and development. Even where sites have been cleaned up to levels that support unrestricted use, information that documents the levels of cleanup that were achieved will be needed.[79] The information needs to be available in a useful and readily accessible form. In order for long-term stewardship to be effective, appropriate information should be readily available to the public and all entities conducting long-term stewardship activities.

APPLICABLE SCOPING COMMENTS
(see Exhibit 2 of Appendix B)

- DOE needs to provide adequate information to the public (4, 18)
- DOE should discuss approaches for preserving information about a site and its past activities and contamination history (2)
- DOE needs to institute a reliable documentation update/revision system to ensure that crucial data on each site are preserved (4)
- DOE should identify processes whereby owners and neighbors are made aware of, in perpetuity, the nature and extent of contamination and use restrictions so that any attrition of personnel and changes in filing and computer systems do not result in a loss of corporate memory (16)
- DOE should establish mechanisms for the collection, retrieval, and storage of information needed for long-term stewardship and site historic preservation programs (1, STGWG)

APPLICABLE ISSUE
(see Exhibit 3 of Appendix B)

5. Information Management

This chapter summarizes recent recommendations for improving DOE's information management requirements and practices to better serve long-term stewardship needs. The chapter also describes DOE's efforts to improve the identification, preservation, and future accessibility of this information.

7.1 Current Responsibilities and Practices

Recent studies have described DOE's information management responsibilities and practices as they pertain to long-term stewardship.[80] Many DOE information management requirements were developed to support nuclear weapons production. The basis for these requirements (e.g., a need for secrecy to protect national security, the assumption that site access will be restricted) was and continues to be critical to the success of national security missions. Conversely, long-term

[79]Even at sites where cleanup achieves unrestricted use, it may be necessary to demonstrate that cleanup to a specified level actually was achieved and/or waste actually was removed to another location (e.g., for litigation or property transfer). It also may be necessary to re-evaluate these sites in response to changes in scientific information or health standards.

[80]*Roadmap to the Year 2000*, U.S. Department of Energy, Records Management Quality Improvement Team, Revision 1, August 1995; *Responsible Openness: An Imperative for the Department of Energy*. U.S. Department of Energy, Openness Advisory Panel, Secretary of Energy Advisory Board, August 25, 1997; *Managing Data for Long-term Stewardship*, Working Draft Report Prepared by ICF Kaiser Consulting Group, March 1998.

stewardship requires public awareness and institutional openness to ensure continued protection of human health and the environment.

Many information management practices that were appropriate during weapons production are counterproductive to long-term stewardship goals, particularly where property, facilities, and other site assets may be leased or transferred to non-DOE entities.

Openness vs. Protection

Although long-term stewardship generally will require open public access to information, some exceptions are necessary to protect national security (e.g., classified material), privacy (e.g., personnel records), and sensitive natural resources and cultural resources. While the need to maintain these protections presents some challenges for long-term stewardship, it should be possible to preserve the mechanisms currently in place to achieve protection during long-term stewardship. For example, DOE currently provides public access to unclassified information at a site (e.g., information related to cleanup) while at the same time maintaining classified information in a variety of secure databases. In addition, some information about cultural resources (e.g., location of archeological sites) is currently exempt from the Freedom of Information Act, and there is no reason to remove such an exemption for long-term stewardship. Tribes and resource management agencies currently use a variety of techniques to inform the public about the existence of sensitive resources without disclosing their exact locations. There is no reason to anticipate that these techniques are incompatible with long-term stewardship.

Exhibit 7-1 provides an overview of current DOE records management practices.[81] Four major aspects of current information management practices are likely to affect DOE's ability to implement long-term stewardship:

1. **Uniform criteria are needed for identifying information critical for long-term stewardship**. A large amount of information is generated every day at DOE sites in support of regulatory and mission requirements. The Department needs to develop a standard methodology for identifying the portion of this information that will be critical to support long-term stewardship.

2. **Data quality must meet current and future needs**. Current uses of data involve evaluations such as whether an engineered control is functioning properly. Future uses of data may involve evaluations such as temporal trends in contaminant concentration or migration.

3. **Information that may be critical for long-term stewardship needs to be preserved**. As site missions, contractors, personnel, and information management technologies change, information is often destroyed or lost. Information also is rendered useless when it is maintained in an obsolete format, or stored in disarray among other records without being

[81] Although the focus of this chapter is on DOE information management practices, management of some long-term stewardship information is governed by external regulation. For example, section 113(k) of CERCLA requires the establishment of an administrative record file containing all information and documentation used in the selection of a response action. This file must contain documents relevant to the selected remedy as well as relevant comments and information, site-specific data, guidance documents, and technical references that the lead agency considered in the ultimate response selection decision. The administrative record file must be made available for public inspection. Regulations in 40 CFR Part 300.800 pertaining to the administrative record establish procedures for public involvement in the development of the administrative record file. *Source: RCRA, Superfund & EPCRA Hotline Training Module, Introduction to Superfund Community Involvement.* U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA540-R-98-027, June 1998.

catalogued or formally archived.[82] Even when information is sent to a storage repository and adequately documented, in some cases the storage repository is mandated to destroy this information after several years.[83]

Exhibit 7-1: Current Records Management Practices

Information is generated at DOE sites to support a variety of regulatory and mission requirements, including cleanup. Once a given piece of information is generated, it may become a "record" as defined by the National Archives and Records Administration (NARA). Records are used for a period of time and, when no longer in active use, are either preserved permanently or saved for a specified period of time and then destroyed.

Books, reports, maps, and other "hard copy" records typically are preserved by placing them in boxes, indexing the boxes, and shipping the boxes to an interim repository at the site. Records are stored in the interim repository for varying periods of time (e.g., 1 year, 25 years, or longer) until they are either destroyed or shipped to an archival repository managed by NARA.

What is a Record?

The National Archives and Records Administration (NARA) defines records to include all books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics. To be managed by NARA, records must be made or received by an agency of the United States Government under Federal law or in connection with the transaction of public business and must be preserved by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the government or because the records contain information of value.

NARA retains the records either permanently or for varying periods of time (e.g., 75 or 80 years). *Records retention schedules* approved by NARA establish specific requirements for preserving and destroying records. Information management practices for electronic materials are evolving. Some electronic materials (e.g., electronic copies of reports) are considered identical to their "hard-copy" counterparts and are preserved in a similar manner. The status of other electronic materials (e.g., databases) is unclear at present. Access to preserved records is achieved by request. The person requesting a record submits a request to NARA (or the organization that manages the onsite repository). Requests for specific records (e.g., an annual report) are filled by locating the box containing the record, retrieving it from storage, extracting the record, and sending a copy to the requestor. Requests for more general information (e.g., all reports that cover groundwater monitoring) are filled by first searching indexing systems to locate potentially relevant records and then following the above retrieval and shipping process. DOE also has developed searchable electronic indexes to certain types of electronic records and has made copies of these records available via the Internet and has developed electronic indexing systems for a variety of hard copy records.

4. **Future generations must be able to locate and readily access the information.** At present, it is difficult to locate and retrieve information from storage repositories without specific knowledge about the existence and archiving of the specific records containing the needed information. For this reason, many of DOE's unclassified documents are effectively

[82]Hedstrom, M. *Playing for Keeps.* Electronic Records Management Conference Proceedings, Canberra, Australia, November 1994.

[83]*DOE Records Retention Schedules.* Available at *http://www-it.doe.gov/records/doers/doers.html*, identify the length of time records are required to be kept. While many critical records are required to be preserved permanently, some records useful for long-term stewardship are required to be retained for less than 100 years. For example, DOE Records Retention Schedule 14: Design and Construction Drawings and Related Records, requires project construction files (including "as built" drawings) for completed projects to be preserved "until dismantlement or disposal of the facility, equipment, system, or process; or when superseded or obsolete; whichever is earlier."

unavailable to the general public.[84] Locating information using general search criteria (e.g., "all soil contamination records from 1995 to 1998") seldom works. When information can be located, it often takes weeks or months to retrieve a record from an archival repository. The search for information is also complicated by the lack of standard methods (e.g., indexing, keywords, geospatial coordinates) for describing and referencing critical information.

In spite of all the cleanup accomplishments to date, if current requirements and practices continue unchanged, future generations may not have access to adequate information to conduct long-term stewardship, and critical information on where and why residual hazards exist may be lost as a result. Failure to generate, identify, and preserve critical information may result in unnecessary exposure to residual hazards, delays in desired site re-use or property transfers, and increased long-term stewardship costs.

Information Management System for Uranium Mill Tailings Sites

DOE is required to conduct long-term surveillance and maintenance of uranium mill tailings sites in accordance with NRC licensing regulations. Information required by NRC regulations includes a detailed description of the final disposal site conditions. frequency and extent of groundwater monitoring, and procedures for site inspections, record keeping and quality assurance (10 CFR Parts 40.27 and 40.28). DOE's Grand Junction Office has developed a document management system to manage more than 50,000 records for nine DOE projects comprising more than 30 DOE sites. Documents in the system contain the following information:

- Present and historical chemical, radioactive, and physical hazards, both natural and man-made, and present and historical releases of contaminants.
- Active and passive devices for preventing exposure to humans and the environment.
- Current (including post-closure) and historical site processes and infrastructure, such as buildings, utilities, pipelines, tanks, and wells.
- Current and historical agreements, regulations, permits, and other legal requirements associated with long-term stewardship.
- Property records related to the site, easements, and other on-site access rights.
- Off-site access rights through public and private property for monitor wells and active or passive control systems, and mineral, water, and other natural resources rights.
- Locations and descriptions of cultural resources and habitats and species of concern.
- Relationship of site resources and access to Native American Tribes or interest groups.
- Site topography, hydrogeology, and geology.
- Site and surrounding property land use.
- Public exposure data.
- Current and historical concerns expressed by the public.

Source: Edge., R. and Pavelka-Zarkesh, L. *Document Systems for Site Stewardship at the U.S. Department of Energy Grand Junction Office.* U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, March 1999.

[84] *Responsible Openness: An Imperative for the Department of Energy.* U.S. Department of Energy, Openness Advisory Panel, Secretary of Energy Advisory Board, August 25, 1997.

7.2 Improving the Ability to Meet Long-term Stewardship Information Needs

The studies cited at the beginning of this chapter identify several recommendations for improving DOE's ability of meet long-term stewardship information management needs. These recommendations, and DOE's efforts to implement them, are discussed below.

- **Develop criteria for identifying critical information**. The first step in such an effort would be to develop a consensus on the types of activities onsite and in the surrounding communities that will require information. The second step would be to identify the information needed to support these activities. The third step would be to develop criteria and guidance for identifying specific site records that meet these information needs. Although complex-wide guidance may ensure a more systematic approach to identifying critical information, individual sites could begin the process independently. Subject matter experts and others (including community members) at each site could identify that subset of current, active records that appear to have long-term value, and site records management organizations could ensure that these records are retained and preserved. Preserving information could provide significant long-term benefit at relatively low cost. In developing the *Report to Congress on Long-term Stewardship at DOE Sites*, DOE has begun to catalogue and report the types of long-term stewardship activities that are to be conducted at its sites in a standardized way. However, the methodology and resulting data apply only to that unique report.

Information Management Systems at the Bureau of Land Management (BLM)

Although BLM does not have a long-term stewardship program in place, their current information management systems and practices have the potential to support long-term stewardship planning and implementation. BLM operates an extensive land use information management system, and possesses expansive current and historical information about land ownership, use, and condition in the United States. The Bureau maintains cadastral survey and historical data on lands patented, along with information on the mineral estate, resource conditions, and permits or leases on Federal lands. BLM also provides other agencies, customers, and the public with efficient and effective means to retrieve and use this information. Preserving records is critical to resolving ownership disputes and are an important source of both historic and resource information.

BLM is using information technology to speed up workflow, improve accuracy, and share information with customers, agency partners, and the public. Determining user requirements, developing systems, collecting and storing data, maintaining systems, and providing for security and training is part of the information technology development process at BLM. BLM uses geospatial tools, including geographic information systems, mapping, remote sensing, and global positioning systems, to acquire and process information. Land managers can use the information to determine the location, extent, and condition of natural resources and to monitor activities on public lands. To respond to demands for faster and more accessible records, the Bureau's land ownership, status, and other records are being automated. Deployment of this automated system, known as the Automated Land and Mineral Record System (ALMRS), began in fiscal year 1998.

Source: U.S. Department of Interior, Bureau of Land Management, *http://www.blm.gov/nhp/what/index.htm*

- **Establish data quality objectives**. It will be important to collect and preserve enough data to support long-term stewardship without overburdening information management systems

with irrelevant information. For example, EPA has developed data quality objectives guidance to assist in focusing data collection and preservation on information critical for environmental decision-making.[85]

- **Establish a clear information baseline at the completion of cleanup**. The baseline information would fully describe the location, condition, and status of all former and residual hazards; a summary of site activities as they pertain to those hazards; and the history of significant public health and environmental impacts to the surrounding communities. This baseline would form the core of information required for long-term stewardship. As noted in Chapter 4, the site-specific long-term stewardship plans required by DOE's Grand Junction Office (GJO) establish an information baseline for sites entering into long-term stewardship, but these plans are required only for closed sites for which GJO has responsibility. In addition, the independent Project Baseline Summaries for long-term stewardship (to be developed by Fiscal Year 2003) will provide a basis for establishing a baseline at many DOE sites (see Chapter 4).

- **Make critical information available to offsite entities**. DOE needs to work proactively with local communities to make information available to allow them to be informed and serve an appropriate role in long-term stewardship. In this way, the information needed for site-specific long-term stewardship activities can be readily identified and utilized as early as possible. This would reduce information management costs during cleanups, help ensure that adequate baselines are established, and ensure that information transfer protocols are established well before all projects at a site are complete. At the same time, sites should work with the offsite entities to improve long-term preservation and access. DOE sites have begun to establish formal agreements to share and disseminate critical information with regulators and local communities. For example, the Rocky Flats Cleanup Agreement among DOE, EPA, the State of Colorado, and several local governments required DOE to create a database of monitoring data and related documents that is accessible to all parties to the agreement. The short-term objective of the database is to improve the effectiveness and efficiency of current monitoring programs, while the long-range goal is to integrate all environmental and natural resource monitoring at the site.[86]

- **Modify existing records retention schedules to meet long-term stewardship information needs**. Federal records retention schedules establish specific requirements for preserving and destroying records, including the length of time records must be retained in an archival repository. Retention times for information critical to long-term stewardship range from essentially zero (information for obsolete facilities and infrastructure is required to be destroyed immediately)[87] to essentially forever (certain records of injuries and residual hazards are required to be retained permanently). Thus, retention times for some critical data should be examined and adjusted to meet long-term stewardship needs. The EM program has

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[85] *Data Quality Objectives process for Superfund: Interim Final Guidance*, U. S. Environmental Protection Agency, EPA/540/G-93/071, September 1993.

[86] Rocky Flats Cleanup Agreement, Part 23, Sampling and Data/Document Availability. July 19, 1996.

[87] *DOE Records Retention Schedule 14: Design and Construction Drawings and Related Records*, available at *http://www-it.doe.gov/records/doers/doers.html.*

begun discussions with the DOE Chief Information Officer to modify DOE records retention schedules to better meet long-term stewardship needs.

Information Management Requirements for the Proposed Geologic Repository at Yucca Mountain

NRC has proposed licensing criteria for disposal of spent nuclear fuel and high-level radioactive waste in the proposed geologic repository at Yucca Mountain. Prior to permanent closure of the repository, DOE is required to provide to NRC a detailed description of the measures to be employed (e.g., land use controls, construction of monuments, preservation of records) to regulate or prevent activities that could impair the long-term isolation of emplaced waste within the geologic repository and to assure that relevant information will be preserved for the use of future generations. Specific information management requirements include:

- Identification of the site and geological repository operations area by monuments that have been designed, fabricated, and emplaced to be as permanent as is practicable.
- Placement of records in the archives and land record systems of local, state, and federal government agencies, and archives elsewhere in the world, that would be likely to be consulted by potential human intruders–such records to identify the location of the geologic repository operations area, including the underground facility, boreholes, shafts, and ramps, and the boundaries of the site, and the nature and hazard of the waste.
- Preservation and maintenance of geologic, geophysical, geochemical, hydrologic, and other site data that are obtained during the operational period.
- Preservation and maintenance of records of the receipt, handling, and disposition of radioactive waste are required to contain sufficient information to provide a complete history of the movement of the waste from the shipper through all phases of storage and disposal.
- Preservation and maintenance of records of the construction of the geologic repository operations in a manner that ensures their usability for future generations.
- Preservation and maintenance of records associated with a program of material control accounting and accidental criticality reporting.

Each record must be legible throughout the retention period (specified by NRC regulations). The record may be the original or a reproduced copy or a microform provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, and specifications must include all pertinent information such as stamps, initials, and signatures, and DOE is required to maintain adequate safeguards against tampering with and loss of records.

Source: 64 FR 8639, February 22, 1999. Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada; Proposed Rule, Nuclear Regulatory Commission, Proposed 10 CFR Parts 2, 19, 20, 21, 30, 40, 51, 60, 61, and 63.

- **Develop appropriate indexing and metadata standards.** The term "indexing" refers to the process of referencing the content of records through keywords, subject codes, and other identifiers. The term "metadata" refers to the content, quality, condition, and other characteristics of data, particularly for electronic formats. Metadata and indexing provide important contextual information, such as where and when data were collected, quality assurance protocols, uncertainties in the data, which is necessary for interpreting and using

information. While certain standard indexing and metadata protocols exist,[88] specific protocols could be developed for DOE issues and residual hazards. The Office of Long Term Stewardship has established a Central Internet Database that provides available information on waste, contaminated media (e.g., water, soil, sediments), spent fuel, materials in inventory, and facilities.[89] The system for referencing these data provides a starting point for developing a more comprehensive referencing system for long-term stewardship data.

Communication Through Time Using Non-Electronic Means

Suggestions on information management presented in this section are intended to supplement, but not replace, existing protocols established by authorities such as the National Archives and Records Administration. Due to the ephemeral nature of electronic technologies, the electronic archiving of long-term stewardship data will not, by itself, provide a secure means to transfer information critical to long-term stewardship to future generations.

The Department intends to use non-electronic means such as monuments and markers to communicate through deep time. For example, DOE will provide archived records, maps, and other information pertaining to the Waste Isolation Pilot Plant in New Mexico to be stored at many locations around the world. At the site itself, DOE also will institute a number of passive controls to warn future generations about the radioactive hazards present in the below-ground repository. These controls will not require continual maintenance, but assume that society in general will maintain some knowledge of the wastes. The controls will include:

- Granite monuments with inscriptions in seven languages.
- A berm surrounding the site that includes radar and magnetic indicators.
- On-site warning markers with information about the waste.
- Informational inscriptions on granite walls.

Source: *Citizens'Guide to the Waste Isolation Pilot Plant Compliance Certification Application to the EPA.* U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, November 1996. DOE/CAO-96-1207.

Other organizations have begun to examine approaches for both thinking and communicating across large periods of time. For example, the Long Now Foundation (*http://www.longnow.org*) was established in 1996 to develop the Clock/Library Projects as well as to become the seed of a very long term cultural institution. The foundation is developing a large, mechanical "10,000 Year Clock" to serve as an iconic focal point for thinking about time. The foundation also intends to found a library of and for the deep future to meet the need for content to go along with the long-term context provided by the Clock. The library could become a repository for kinds of information deemed especially useful over long periods of time, such as minding extreme longitudinal scientific studies, or accumulating a 'Responsibility Record' of policy decisions with long-term consequences.

- **Develop a system to facilitate public access to and retrieval of critical information.** A system should be developed to enable a person with limited knowledge of DOE sites to be able to easily search, find, and understand relevant information. An effective system might include both "hard copy" and electronic elements. An effective "hard copy" system might include information centers or displays at the site or in nearby communities; maintenance of

[88]For example. Executive Order 12096, *Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure* requires federal agencies to ensure that all geospatial data are collected in a manner that meets all relevant standards adopted by the Federal Geographic Data Committee, an interagency committee established by the Office of Management and Budget.

[89]Available at *http//cid.em.doe.gov*.

site files in local libraries; and periodic updates of all hard-copy materials and records indexes. An effective electronic system might include (1) an electronic archive where digitized copies of all critical records are kept; (2) an electronic index consisting of a standard thesaurus of reference terms, uniform metadata, and consistent geospatial referencing; (3) a system for delivering electronic copies of records to its patrons; (4) a user interface with a search engine for identifying and locating relevant records; and (5) a maintenance system to ensure that electronic technologies remain current. The Central Internet Database provides a step in this process. The overall system also might include periodic training and education of local librarians and other information management professionals.

- **Integrate information management considerations into all site missions.** Under current business practices, information management is considered a "support" or "overhead" function that is adjunct to DOE site missions. As a consequence, funding to support information management improvement directly competes with funding for accelerated cleanup. This competition is likely to continue until DOE recognizes information management as an integral part of *all* missions, including national security, cleanup, and long-term stewardship. Such recognition could be achieved by creating information management "projects" within the EM program budget and including information management requirements in all business transactions. DOE has not initiated a specific effort to projectize information management. However, the Office of Long Term Stewardship has identified information management as a high-priority science and technology need (see Chapter 4).

7.3 Developing an Institutional Framework for Managing Critical Information

Although DOE sites can take many steps now toward improving information management practices, a more systematic approach may be needed to coordinate and focus efforts throughout the DOE complex. The necessary framework would include an organization, or a network of organizations, which would have the authority, mission, and funding to identify, preserve, and provide access to information critical to long-term stewardship. There are three general options for developing such a framework: dispersed, concentrated, and hybrid (see Exhibit 7-2).

Finding the appropriate balance between local (dispersed) and central strategies for the archival and management of information will be challenging. The architecture of the World Wide Web provides a useful model for discussion – the server(s) upon which databases reside represent the data archive(s); the internet represents the means of accessing data; search engines represent the means of finding data; and desktop computers represent the points of access. It clearly would be advantageous for points of access to be widely dispersed; and search engines can be rapidly updated. The more difficult choice is how to distribute critical information among one or more servers. On the one hand, there appears to be a clear need for one or more central repositories as a backup so that failure of one or more local servers does not result in information loss. A central repository also would provide maximum configuration control over both data and hardware/software requirements. On the other hand, long-term stewardship information needs and preferences for archiving and disseminating this information will be somewhat site-specific, so a degree of flexibility in the design of databases and search engines will likely be needed. This, in turn, would make configuration control more difficult, especially with respect to hardware/software requirements. The ultimate solution is likely to be some type of hybrid

between dispersed and central control, but more dialogue is required before this issue can be resolved.

Exhibit 7-2. Options for an Institutional Framework to Manage Critical Information

Option	Advantages	Disadvantages
Dispersed – multiple, site-specific entities would be responsible for managing information. No central management entity would exist.	Most flexible alternative. The number, structure, and responsibilities of entities could be matched with site-specific needs.	Coordination among numerous entities would be difficult. Difficult to ensure that existing and future requirements, standards, and protocols are being followed. Configuration control would be difficult.
Concentrated – a single, national entity would be responsible for managing information. No site-specific entities would exist.	Most efficient alternative. Relatively easy to maintain standards and practices and to ensure technologies are current. Configuration control would be maximized.	Least flexible alternative. Uniform approach to diverse, site-specific information management needs may not be appropriate.
Hybrid – some information management responsibilities would be concentrated in a single entity; others would be dispersed among multiple, site-specific entities.	Intermediate in terms of flexibility, efficiency, and the need to maintain coordination. A single entity could maintain overall responsibility for managing system (e.g., ensuring standards and protocols are followed; updating technologies). Other entities could be responsible for specific types of information (e.g., local governments could manage real estate records).	

Other federal agencies have established institutional frameworks for managing stewardship information. NRC procedures for transfer of information (10 CFR Part 61.80) provide an approach that could be used to improve information management at DOE sites. NRC requires records to be maintained for the duration of the license. Upon termination of the license, information is to be transferred to local, state, and federal agencies, unless the property is being transferred to another licensee. The NRC draft Standard Review Plan notes that any transfer of land for restricted use by a licensee should be accompanied by a transfer of information and information management procedures for the property.[90] The Bureau of Land Management has established information management systems for Agency land records. The National Park Service has established a Geologic Resources Department to manage data and information for more than 2,400 sites in the Abandoned Mine Lands Program.[91] The Geologic Resources Department is in the process of collecting information for these sites, and the Department is anticipated to remain in operation for the duration of remedial activities at the Abandoned Mine Lands Program sites, which will be at least several decades.

[90]Draft Standard Review Plan 16.0. Nuclear Regulatory Commission, Nuclear Material Safety and Safeguards, Decommissioning Program; 10 CFR Part 61.80.

[91]U.S. Department of Interior, National Park Service, *www1.nature.nps.gov/facts/faml.htm.*

Information Management Systems for Radioactive Waste Disposal Sites

The International Atomic Energy Agency has issued guidance for developing a system for maintaining information pertaining to near surface radioactive waste disposal sites and geologic repositories. The guidance calls for the identification of:

- The types of information of most value to future generations.
- The physical form, location, indexing, and retention schedules for this information.
- Measures to be taken to ensure the continued collection and maintenance of records.
- A schedule for transfer of the collected information into a Records Management System (RMS) during the lifetime of the site.
- Methods to ensure that the information will remain accessible and understandable to future generations.
- Remedial actions to be taken in the event of records deterioration.

The guidance advocates establishing a hierarchal structure of long-term stewardship information for disposal sites, including:

- A Primary Level Information Set, consisting of all of the records continuously developed during the lifetime of the site.
- An Intermediate Level Information Set, consisting of the condensed important documentation that is necessary to ensure an understanding of the disposal site system and the contents and location of the Primary Level Information Set. This data set consists mainly of the records needed to meet the regulatory and licensing requirements of the disposal site.
- A High Level Information Set, consisting of the information sufficient to provide a more fundamental understanding of the disposal system. This data set should provide sufficient information for future generations to make informed decisions concerning the consequences of intentional actions and unforeseen occurrences pertaining to the disposal site.

The rationale for creating a hierarchal structure of information, rather than managing all of the information in a single manner, is to ensure that information most critical to future generations is preserved. A condensed and essential set of data may be more useful and understandable to future generations than a massive archive of both essential and nonessential information that would be provided by a Primary Level Information Set. The guidance advocates national and international archiving of the High Level Information Set to counteract the threats to a single repository of information.

Source: *Maintenance of Records for Radioactive Waste Disposal.* International Atomic Energy Agency, Waste Technology Section, Vienna, Austria. IAEA-TECDOC-1097, July 1999.